81. (Amended) The method according to claim 47, wherein a concentration of said nickel in said first region is $1 \times 10^{19}$ atoms/$cm^3$ or lower.

## REMARKS

Applicant would like to thank the Examiner for the consideration given the present application. The Office Action of **September 14, 2001**, has been received and its contents carefully noted. Concurrently filed herewith is a *Petition for a One (1) Month Extension of Time* that extends the shortened statutory period until January 14, 2002. Accordingly, Applicant respectfully submits that this response is timely filed and fully responsive to the Office Action.

Claims 5-12, 16, 19, 26-47 and 67-81 were pending in the present application prior to the aforementioned amendment. By the above amendment, claims 27, 31, 33, 36, 42, 45, 47 and 76-81 are amended to more clearly recite protection to which Applicant is already entitled. Applicant submits that no issue of new matter is set forth by this amendment. Accordingly, claims 5-12, 16, 19, 26-47 and 67-81 are currently pending in the subject application, and are believed to be in condition for allowance at least for the reasons advanced hereinbelow.

Initially, the Office Action further rejects claims 5-8, 11, 12, 16, 19, 27-48 and 67-81 under 35 U.S.C. §103(a) as unpatentable over ***Oka '915*** in view of ***Liu et al. '826***, ***Kuznetsov*** and ***Kuomi***, claims 9, 10 under 35 U.S.C. §103(a) as unpatentable over ***Oka '915*** in view of ***Liu et al. '826***, ***Kuznetsov***, ***Kuomi***, ***Yonehara '093*** and/or ***Shibata '224***, and claim 26 under 35 U.S.C. §103(a) as unpatentable over ***Oka '915*** in view of ***Liu et al. '826***, ***Kuznetsov*** and ***Kuomi***. Applicant traverses these rejections at least for the reasons solicited hereinbelow.

The claimed invention is directed generally to a method of manufacturing a semiconductor device, including, *inter alia*, the steps of forming a semiconductor film to be crystallized over a substrate, the semiconductor film having a first region and a second region, disposing a metal containing material in contact with a selected region of only the first region of the semiconductor film, the metal being capable of promoting crystallization of the semiconductor film, heating the semiconductor film so that crystallization of the semiconductor film occurs only in the first region thereof while the semiconductor film in the second region is not crystallized, wherein the crystallization proceeds in a direction parallel to a major surface of the substrate from the selected region with diffusion of the metal through the semiconductor film, thereby forming crystals of the semiconductor film in the first region extending parallel with the major surface of the substrate, patterning the semiconductor film in order to form a first semiconductor island consisting of the first region and a second semiconductor island consisting of the second region and forming a first thin film transistor by using the first semiconductor island and a second thin film transistor by using the second semiconductor island. In accordance with the claimed invention, the first thin film transistor is arranged so that the crystals extend along with a direction in which carriers of the first thin film transistor flow.

It should be noted that three criteria must be met to establish a *prima facie* case of obviousness. *M.P.E.P.* §2143. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings to achieve the claimed invention. *Id.* Second, there must be a reasonable expectation of success. *In re Rhinehart*, 531 F.2d 1048, 189 USPQ 143 (CCPA 1976). Third, the prior art must teach

or suggest all the claim limitations. *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974).

Applicant respectfully contends that the base ***Oka '915*** patent, either alone or in combination with of ***Liu et al. '826***, ***Kuznetsov***, ***Kuomi***, ***Yonehara '093*** and/or ***Shibata '224***, fails to expressly teach or inherently suggest all the claim limitations of the claimed invention necessary to support a *prima facie* case of obviousness. Referring now to the prior art of record, the Office Action maintains that the ***Oka '915*** patent discloses in Figs. 5-8 that "grain growth proceeds from the seed regions parallel to the substrate surface and the TFT carrier flow." Assuming, *arguendo*, that the ***Oka '915*** patent discloses grain growth in parallel to the substrate surface, there is no express teaching or implicit suggestion in the ***Oka '915*** patent for arranging crystals along a carrier flow direction of TFTs. In fact, in Applicant's review of the teachings provided in the ***Oka '915*** patent, Figs. 5-8 of the ***Oka '915*** patent merely discloses arranging the channel region within the region 505 at which the probability of the presence of the crystal growth boundary is practically zero.

Moreover, the ***Oka '915*** patent discloses forming a seed region 503, a region 504 at which the probability of crystal grain boundary is high, a region 505 at which the probability of the presence of the crystal growth boundary is practically zero, and a region 506 between regions 504 and 505. (See, pg. 12, lines 4-18, Full English translation of ***Oka '915***). The ***Oka '915*** patent further discloses that a portion at which the crystal grain boundary should be present can be controlled, and thus, it becomes possible to selectively form a semiconductor element in a crystallized region. (See, pg. 15, lines 2-6, Full English translation of ***Oka '915***).

Accordingly, it appears that the ***Oka '915*** patent merely discloses forming the semiconductor element at which the degree of the crystal grain boundaries have been controlled, and never suggests arranging TFTs in a direction parallel to the crystal growth direction so that the carrier flows in parallel to the crystal growth direction. On the other hand, in accordance with the claimed invention as set forth at least in claims 27, 31, 33, 36, 42, 45 and 47, a first TFT is arranged so that the crystals extend along with a direction in which carriers of the first thin film transistor flow. The secondary ***Liu et al. '826***, ***Kuznetsov***, ***Kuomi***, ***Yonehara '093*** and ***Shibata '224*** references fail to modify ***Oka '915*** in a manner that would render the claimed invention since neither reference expressly discloses or inherently suggests such a feature.

Accordingly, since the proposed ***Oka '915*** modifications fail to expressly teach or inherently describe each and every claim limitation necessary to support a finding of *prima facie* obviousness under §103, it is respectfully requested that the rejection be reconsidered and withdrawn. If the Examiner believes further discussions with Applicants' representative would be beneficial in this case, he is invited to contact the undersigned.

Respectfully submitted,

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**Marked-up Copy of Amended Claims**

27. (Amended) A method of manufacturing a semiconductor device comprising the steps of:

forming a semiconductor film to be crystallized over a substrate, said semiconductor film having a first region and a second region;

disposing a metal containing material in contact with a selected region of only the first region of the semiconductor film, said metal being capable of promoting crystallization of said semiconductor film;

heating said semiconductor film so that crystallization of said semiconductor film occurs only in the first region thereof while the semiconductor film in said second region is not crystallized, wherein said crystallization proceeds in a direction parallel to a major surface of said substrate from said selected region with diffusion of said metal through the semiconductor film, thereby forming crystals of said semiconductor film in said first region extending parallel with the major surface of the substrate; [and]

patterning said semiconductor film in order to form a first semiconductor island consisting of the first region and a second semiconductor island consisting of the second region[,]; and

forming a first thin film transistor by using said first semiconductor island and a second thin film transistor by using said second semiconductor island,

wherein [a concentration of said metal in said first region is $1 \times 10^{19}$ atoms/$cm^3$ or lower] said first thin film transistor is arranged so that said crystals extend along with a direction in which carriers of said first thin film transistor flow.

31. (Amended) A method of manufacturing a semiconductor device comprising the steps of:

forming a semiconductor film to be crystallized over a substrate, said semiconductor film having a first region and a second region;

disposing a metal containing material in contact with a selected region of only the first region of the semiconductor film, said metal being capable of promoting crystallization of said semiconductor film;

heating said semiconductor film so that crystallization of said semiconductor film occurs only in the first region thereof while the semiconductor film in said second region is not crystallized, wherein said crystallization proceeds in a direction parallel to a major surface of said substrate from said selected region with diffusion of said metal through the semiconductor film, thereby forming crystals of said semiconductor film in said first region extending parallel with the major surface of the substrate; [and]

patterning said semiconductor film in order to form a first semiconductor island consisting of the first region and a second semiconductor island consisting of the second region[,]; and

forming a first thin film transistor by using said first semiconductor island and a second thin film transistor by using said second semiconductor island,

wherein [a concentration of said metal in said first region is $1 \times 10^{19}$ atoms/$cm^3$ or lower] said first thin film transistor is arranged so that said crystals extend along with a direction in which carriers of said first thin film transistor flow, and

wherein a concentration of said metal in said second region is lower than that in said first region.

33. (Amended) A method of manufacturing a semiconductor device comprising the steps of:

forming a semiconductor film to be crystallized over a glass substrate having a glass strain point of 593°C or less, said semiconductor film having a first region and a second region;

disposing a metal containing material in contact with a selected region of only the first region of the semiconductor film, said metal being capable of promoting crystallization of said semiconductor film;

heating said semiconductor film so that crystallization of said semiconductor film occurs only in the first region thereof while the semiconductor film in said second region is not crystallized, wherein said crystallization proceeds in a direction parallel to a major surface of said substrate from said selected region with diffusion of said metal through the semiconductor film, thereby forming crystals of said semiconductor film in said first region extending parallel with the major surface of the substrate; [and]

patterning said semiconductor film in order to form a first semiconductor island consisting of the first region and a second semiconductor island consisting of the second region[,]; and

forming a first thin film transistor by using said first semiconductor island and a second thin film transistor by using said second semiconductor island,

wherein [a concentration of said metal in said first region is $1 \times 10^{19}$ atoms/$cm^3$ or lower] said first thin film transistor is arranged so that said crystals extend along with a direction in which carriers of said first thin film transistor flow.

36. (Amended) A method of manufacturing a semiconductor device for an active matrix type electro-optical display having a driving circuit portion and a display portion comprising the steps of:

forming a semiconductor film to be crystallized over a substrate, said semiconductor film having a first region on said driving circuit region and a second region on said display portion;

disposing a metal in contact with a selected region of only the first region of the semiconductor film, said metal being capable of promoting crystallization of said semiconductor film;

heating said semiconductor film so that crystallization of said semiconductor film occurs only in the first region thereof while the semiconductor film in said second region is not crystallized, wherein said crystallization proceeds in a direction parallel to a major surface of said substrate from said selected region with diffusion of said metal through the semiconductor film, thereby forming crystals of said semiconductor film in said first region extending parallel with the major surface of the substrate; and

after the crystallization of said semiconductor film, forming a first thin film transistor by using said crystals of the semiconductor film and a second film transistor by using the second region of the semiconductor film, [and]

wherein [a concentration of said metal said first region is $1 \times 10^{19}$ atoms/$cm^3$ or lower] <u>said first thin film transistor is arranged so that said crystals extend along with a direction in which carriers of said first thin film transistor flow</u>.

42. (Amended) A method of manufacturing a semiconductor device comprising the steps of:

forming a semiconductor film to be crystallized over a substrate, said semiconductor film having a first region and a second region;

disposing a metal containing material in contact with a selected region of only the first region of the semiconductor film, said metal being capable of promoting crystallization of said semiconductor film;

heating said semiconductor film so that crystallization of said semiconductor film occurs only in the first region thereof while the semiconductor film in said second region is not crystallized, wherein said crystallization proceeds in a direction parallel to a major surface of said substrate from said selected region with diffusion of said metal through the semiconductor film, thereby forming crystals of said semiconductor film in said first region extending parallel with the major surface of the substrate; [and]

patterning said semiconductor film in order to form a first semiconductor island consisting of the first region and a second semiconductor island consisting of the second region[,]; and

forming a first thin film transistor by using said first semiconductor island and a second thin film transistor by using said second semiconductor island,

wherein [a concentration of said metal in said first region is $1 \times 10^{19}$ atoms/$cm^3$ or lower] said first thin film transistor is arranged so that said crystals extend along with a direction in which carriers of said first thin film transistor flow, and

wherein said first region and said second region each includes hydrogen.

45. (Amended) A method of manufacturing a semiconductor device comprising the steps of:

forming a semiconductor film to be crystallized over a substrate, said semiconductor film having a first region and a second region;

disposing nickel in contact with a selected region of only the first region of the semiconductor film;

heating said semiconductor film so that crystallization of said semiconductor film occurs only in the first region thereof while the semiconductor film in said second region is not crystallized, wherein said crystallization proceeds in a direction parallel to a major surface of said substrate from said selected region with diffusion of said nickel through the semiconductor film, thereby forming crystals of said semiconductor film in said first region extending parallel with the major surface of the substrate; [and]

patterning said semiconductor film in order to form a first semiconductor island consisting of the first region and a second semiconductor island consisting of the second region[,]; and

forming a first thin film transistor by using said first semiconductor island and a second thin film transistor by using said second semiconductor island,

wherein [a concentration of said nickel in said first region is $1 \times 10^{19}$ atoms/$cm^3$ or lower] said first thin film transistor is arranged so that said crystals extend along with a direction in which carriers of said first thin film transistor flow.

47. (Amended) A method of manufacturing a semiconductor device comprising the steps of:

forming a semiconductor film to be crystallized over a substrate, said semiconductor film having a first region and a second region;

disposing nickel in contact with a selected region of only the first region of the semiconductor film;

heating said semiconductor film so that crystallization of said semiconductor film occurs only in the first region thereof while the semiconductor film in said second region is not crystallized, wherein said crystallization proceeds in a direction parallel to a major surface of said substrate from said selected region with diffusion of said nickel through the semiconductor film, thereby crystals of said semiconductor film in said first region extending parallel with the major surface of the substrate; [and]

patterning said semiconductor film in order to form a first semiconductor island consisting of the first region and a second semiconductor island consisting of the second region[,]; and

forming a first thin film transistor by using said first semiconductor island and a second thin film transistor by using said second semiconductor island,

wherein [a concentration of said nickel in said first region is $1 \times 10^{19}$ atoms/$cm^3$ or lower and higher than that in said second region] said first thin film transistor is arranged so that said crystals extend along with a direction in which carriers of said first thin film transistor flow.

76. (Amended) The method according to claim 27, wherein [a first thin film transistor is formed by using said first semiconductor island, so that the direction of the crystallization proceeding coincides with a carrier flow direction of said first thin film

transistor] a concentration of said metal in said first region is 1 x $10^{19}$ atoms/$cm^3$ or lower.

77. (Amended) The method according to claim 33, wherein [a first thin film transistor is formed by using said first semiconductor island, so that the direction of the crystallization proceeding coincides with a carrier flow direction of said first thin film transistor] a concentration of said metal in said first region is 1 x $10^{19}$ atoms/$cm^3$ or lower.

78. (Amended) The method according to claim 36, wherein [the direction of the crystallization proceeding coincides with a carrier flow direction of said first thin film transistor] a concentration of said metal in said first region is 1 x $10^{19}$ atoms/$cm^3$ or lower.

79. (Amended) The method according to claim 42, wherein [a first thin film transistor is formed by using said first semiconductor island, so that the direction of the crystallization proceeding coincides with a carrier flow direction of said first thin film transistor] a concentration of said metal in said first region is 1 x $10^{19}$ atoms/$cm^3$ or lower.

80. (Amended) The method according to claim 45, wherein [a first thin film transistor is formed by using said first semiconductor island, so that the direction of the crystallization proceeding coincides with a carrier flow direction of said first thin film

transistor] a concentration of said nickel in said first region is 1 x $10^{19}$ atoms/$cm^3$ or lower.

81. (Amended) The method according to claim 47, wherein [a first thin film transistor is formed by using said first semiconductor island, so that the direction of the crystallization proceeding coincides with a carrier flow direction of said first thin film transistor] a concentration of said nickel in said first region is 1 x $10^{19}$ atoms/$cm^3$ or lower.